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ABSTRACT

This paper examines how, why, and by whom technology is being used in schools. Educational technology is defined as the systematic design and use of hardware and software to achieve specific objectives. Recent studies indicate that the most frequent location of computers in schools is in the administrative office; second is in the library media center and third in a computer lab. Computers are used mostly for word processing, followed by drill and practice and educational games. The following rationales for using computers in schools are identified: social, vocational, pedagogic, and catalytic. In the United States, the social and vocational rationales are dominant. Some studies show that computer-based programs in elementary education benefit only the highest scoring students and students taught by teachers most knowledgeable about the computer system being used; in colleges and universities only about 10 percent of the faculty use technology in the classroom. Factors that contributed to one elementary school's successful use of technology were: availability of computers in the classroom; support and sharing of resources; a supportive district and principal; a strong computer coordinator; early and thorough teacher training; and user-friendly systems. Conditions leading to successful implementation of technology in schools are: dissatisfaction with the status quo; knowledge and skills; resources; rewards and incentives; commitment; leadership; time; and participation. The following ideas should be considered: creating conditions for learners to become responsible for their own learning; helping learners use the right tools; how to "humanize" technology; and helping learners raise the "right" questions. (Contains 14 references.) (AEF)

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ED 381 152

TECHNOLOGY IS THE ANSWER! But What Was the Question ?*

by Donald P. Ely

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TECHNOLOGY IS THE ANSWER!
But What Was the Question?*

A person does not have to go very far to interact with technology today. On any given day a person is awakened by a digital alarm clock that eminates music, voice or an insistant alarm. There may be a message waiting on the answering machine from an overnight call. On the way to work, the control panel on the car indicates status of the vehicle through small computer chips that monitor several functions. A stop at the bank means an interface with the ATM to obtain cash for the day. Once in the office, the first activity of the day is to check e-mail that has been sent from many parts of the world. And so it goes from one technological application to another--all aimed toward making life (and work) more efficient, pleasurable and convenient. And what about school?

Computers are ubiquitious. Almost every school in the United States has computers and 75% of them have network capabilities (Heaviside and Farris, 1995). The student/computer ratio (microdensity) has increased from 1/75 in 1984 to 1/12 last year (Quality Education Data, 1994). Seventy-four percent (74%) of the schools have cable television access (Heaviside and Farris, 1995) which translates to over 35 million students (Kamil, 1995). Ninety-eight percent (98%) of the schools have videotape recorders. Equipment does not seem to be a major problem despite major financial limitations in many school systems and universities.

Online computer networks are in the spotlight now. The Internet is probably the best kno vn of all networks with over 13,500,000 users (as of yesterday afternoon) and growing at rate of about 2,000 users every day.

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* The James P. Curtis Distinguished Lecture, Capstone College of Education Society, College of Education, University of Alabama, April 14, 1995.

The potentials for access to all kinds of information are overwhelming and the opportunities for connecting to individuals all over the world are mind-boggling. We are developing virtual communities through virtual libraries (information online and stored on CD-ROMs, for example) and virtual classrooms (through the wonders of satellite and cable-delivered distance education) and the end is not in sight. Soon it may not be possible to tell the functional difference between reality and apparent reality in the home, community and classroom.

What are the common threads running through the fabric of technology in education and society? Interaction; engagement; community communication--all made possible by digital technologies that are widely available, relatively inexpensive, and (for the most part) easy to use.

There is no doubt that we live in an information age and that technololgy is the symbol of progress. Each day brings new products, new applications, new hardware and software and new opportunities to connect with information resources and people. There is an inevitability about the growth of information technology. We expect new developments, new products and new experiences. I have the uncomfortable feeling that we often overlook the reasons for all of the innovations. We do not seem to ask, "Why?" We have been swept up by the tide of technology without fully understanding what purpose its serves and the ultimate consequences of our adoption and use. Robert Snider (1972) said that technology often produces confusion over human means and human ends. When technology makes it possible for people to do something, people do it, not always because it is necessary, but because it is possible. In the process, technology sometimes raises new moral issues related to long-held goals that can now be achieved with unimagined effectiveness. For example, how fast do we want to move across the face of the earth? For how long shall we defer death?

Technology

We must be careful about use of the word, *technology*. There is much *meaning* in the word if we want to explore it. Technology is often used as a synonym for *hardware--machines; equipment.* At best, some think of technology as *hardware + software* but not many people take it further. What we really need to know is why technology is in the school (or home, university, workplace) and how it is being used and what results have occurred as a result of its use.

Technology, according to Webster's Third, is "...the application of scientific knowledge to practical purposes in a particular field." Sometimes the process is reversed; that is, technological developments precede scientific work. James Watts' steam engine for example, was efficiently running the mills of England for 75 years before a scientific explanation of this phonomenon was forthcoming. There is not much "scientific knowledge" in computer hardware, cable connections or satellite television except in the design of the instruments themselves. These are the vehicles that deliver the software that can be applied to "practical matters." What is delivered is not knowledge, but data and information; there IS a difference!) Even the hardware + the software does not accomplish much until it is designed and used to engage individuals--in a game, an accounting problem, or a physics experiment. The systematic design and use of hardware and software to achieve specific objectives is the way I view educational technology.

We complain that "technology" often makes decisions for us. We say that "television" has a negative influence on children. We curse the computer error in our bills from the credit card company. But, it is not the hardware, the television set or the computer terminal that creates our concerns; it is the way in which the software has been designed and the way it has been used (or abused) that brings about these feelings of frustration. Technology is amoral. In itself it is neither good nor bad, humane or inhumane. The morality of any technology is a function of its use as it is applied. Technology, in the sense that has been described here is our friend--a process or tool that can be used to solve problems and make our life more

satisfying. Yes, *technology is the answer! But what was the question?*

Disturbing Indicators

We may feel comforted that there is hardware and software in the schools. **But...the questions** are:

How is it being used? By whom? For what purpose? How often? and With what results?

Schools feel that they must have technology to be up-to-date. If technology is equated to hardware, the statistics are proof of the ubiquitous nature of technology in the schools: in 1994, approximately $2.4 billion was spent for educational technology in the K-12 schools (QED, 1994). Higher education spent about $6 billion (Geoghagen, 1994). A report of the Software Publishers Association says that "...more than half the schools in the country now use computers in almost every discipline."

There is a rush to technology unlike any previous time. Historical cycles of technology in Education often mirror cycles in other sectors of society. These cycles often characterize an era. In this Century alone, we have seen the rise and fall of such media as lantern slides, sound recordings, silent (and then sound) movies, filmstrips, radio and teaching machines. Now computers and television can be found in almost every school and college in the land. One common theme that has run through the introduction of each new medium is that each one was an aid (an enhancement, enrichment) to the teaching/learning process. None of these media became so pervasive that comprehensive instructional programs were designed to make them integral to the syllabus or curriculum. That is, no teacher was ever required to use these media; it has been possible to teach a class, a unit, a course or a curriculum without using any of them. It is the same today. Computers are add-ons. They rarely supplant other media and methods. They may supplement other resources, but they are rarely integral to the process of teaching/learning. Carol Twigg, Vice President of EDUCOM and leader of the National Learning Infrastructure Initiative is quoted as saying that the problem with all the uses of

information technology in the last decade--computer-aided instruction, networked information, distance learning--"...is that they were bolted onto current instructional methods." (Reinhardt, 1995) How then are computers used in schools today?

If we look at recent studies, we find the most frequent location of computers is in the administrative office of the school; second is in the library media center and third in a computer lab (Heaviside and Farris, 1995). Eighty-five percent of school librarians have multimedia computers and half have Internet accounts (Chronicle of Higher Education, 1995). Computers do not find their way into classrooms as often as to other locations in the school. Analysis of current practices indicate that the most frequent use is for word processing followed by drill and practice and educational games (Pelgrum and Plomp, 1990). Only 3% of all instructional spaces in public schools are connected to the Internet (Heaviside and Farris, 1995).

An astute analysis of computer use in schools was developed by David Hawkridge (1990). He specifies four rationales for using computers in schools:

The social rationale. Policy makers want to be sure that all children are "aware and unafraid of how computers work." Because "computers are pervading industrial societies and are likely to be important in all countries," learners should be prepared to understand computers and be aware of their role in society. *The social rationale.*

The vocational rationale. Learning to operate computers is an important competency. "Teaching children programming gives them some confidence in their ability to control computers, and may be a foundation for a career in computer science." There will be employment opportunities for people who have the proper computer skills. *The vocational rationale.*

The pedagogic rationale. Students can learn from computers: "computers can teach." There are advantages over traditional methods when using computers to learn. No specific type or amount of learning is specified. *The pedagogic rationale.*

The catalytic rationale. "Schools can be changed for the better by the

introduction of computers." Computers facilitate change. They are symbols of progress. They encourage learning. "Computers are seen as catalysts, enabling desired change in education to occur (Hawkridge, et.al., 1990)." *The catalytic rationale.*

In the United States, the *social* and *vocational* rationales seem to dominate. The rapid and extensive adoption of computers in the schools reinforces the notion that computers are symbols of modern schools. It is the *pedagogic* and *catalytic* rationales that seem to be diminished in our schools. The basic reason for this status is that we have not asked the right questions about why, how, and with what results?

But...*what difference do they make?* A recent report of a $24 million investment in educational technology in a Detroit, Michigan school district indicated that students who used it continued to remain near the bottom of test scores three (3) years later (Heller Report, 1995). Henry Becker, a University of California psychologist said, "In education, our expectations for what can be done with computers are unduly inflated by our persistent tendency to publicize only our successes...Even worse is the widespread attention we give to partial anecdotal evidence that some children have achieved remarkable things using technology." Becker's studies have shown that computer-based programs at the elementary school level really benefit only two groups of students--the initially highest scoring students and students taught by teachers most knowledgeable about the computer system being used (Becker, 1990).

The picture is not much brighter in colleges and universities. William Geoghegan, a former university professor and academic administrator, and now consultant to IBM for higher education says that "...recent surveys (show)...that no more than about 10 percent of faculty are doing very much with technology in the classroom, despite a national ownership rate for PCs of about 50 percent among college and university faculty...." (Geoghagen, 1994)

A bold red headline in a current library publication says: "New technology is exciting. It can also be expensive, inefficient, and exactly what you don't need." and goes on to point out the advantages of microfilm and microfiche.

The cover story in last month's *Byte* magazine says that "Computers in the schools have soaked up huge capital expenditures without providing any appreciable return on investment." Further in the article, the author concludes that "Technology alone is not the solution. Reaping the benefits of computers first requires extensive teacher training, new curricular materials, and, most important, changes in educational models (Reinhardt, 1995 p. 52).

The research findings about learning from computers in schools are sparse and unconvincing. We **do** know that computers are motivating, especially with younger learners; they like to use them. We **do** know that appropriate use of technology can boost retention rates and we **do** know that the use of technology can reduce boredom and misbehavior. The jury is still out on student achievement because most studies have focused on use of the hardware and have not asked the "right" questions about the software and how it has been used, the type of learner who is using it, and the appropriateness for attaining certain curricular objectives. For the most part, teachers are puzzled because: (1) they are unsure **how** to use technology; (2) they question **why** they should use it; and (3) they do not know where to place it in the curriculum. When media are used, they appear to be **add-ons** most of the time with little direct relevance to the curricula being taught.

In the current issue of *Educational Technology* magazine, there is confirmation of the uncertainty about computer use in schools:

> "If we look at how computer technology is actually being used in the service of education, it is not surprising to find that it turns out to play a very traditional role. It is either viewed as a matter of isolated subject mastery, or as a means of augmenting and enhancing the material to be learned--that is, merely as another tool for presenting the same conceptual toolkit of accepted methods and means

representing the body of knowledge currently embraced by the educational system (Lazlo and Castro, 1995).

It is unfortunate that with all the excitement and obvious high motivation of students in using technology, that schools and universities, by and large, have not made appropriate or optimal use of the technological resources at hand to improve teaching and learning. Perhaps before we decide to purchase any more hardware or software or conduct any more teacher workshops, we should stop and ask: "What was the question?"

In the popular press, Clifford Stoll has strong words about the wisdom of virtual communities and virtual classrooms in his new book, *Silicon Snake Oil.* He is concerned about Internet "home pages" that offer electronic gateways to any location in the world and are enticing computer users away from nonvirtual pursuits--away from talking with each other, reading books and looking up at the sky. Stoll goes on to say that "The key ingredient of their silicon snake oil is a technocratic belief that computers and networks will make a better society. Access to information, better communications and electronic programs can cure social problems. I don't believe them." he adds. "...There are no simple technological solutions to social problems...The most important interactions in life happen between people, not between computers." He finds the idea that computers are tools disturbing. "A tool for what? A tool for thinking? Is reasoning so painful that we require a labor-saving device?" Strong words; perhaps too strong but they offer a warning flag to potential problems down the road.

A Plea for Sanity and Planning

The cynical comments about the bleakness of technology's contributions to schools should be tempered by the fact that we live in a technological society and schools are part of that society. We cannot escape the reality of the information age in which we live any more than we can avoid the need for a radio or a telephone in our everyday life. We are caught up in the web of technology. It can serve us well; it can help us to solve some of our most pressing problems in education if only we

can step back from it as Robert Persig did in his classic *Zen and the Art of Motorcycle Maintenance.*

> The way to solve the conflict between human values and technological needs is not to run away from technology. That's impossible. The way to resolve the conflict is to break down the barriers of dualistic thought that prevent a real understanding of what technology is--not an exploitation of nature, but a fusion of nature and the human spirit into a new kind of creation that transcends both. When this transcendence occurs in such events as the first airplane flight across the ocean or the first footstep on the moon, a kind of public recognition of the transcendent nature of technology occurs. But this transcendence should also occur at the individual level, on a personal basis, in one's own life, in a less dramatic way (Pirsig, 1974).

In speaking of school reform, the term "transformation" is often used. As we consider major changes in our schools and universities, and the role of technology in those changes, we need to ask some very fundamential questions:

* What are we trying to accomplish in our schools and universities?
* What do we know about the learners we are trying to reach?
* What can best learned alone or in small groups? in large groups?
* What specific skills do we want our students to acquire and how will we know when they have achieved competence?

A recent discussion group on the Internet inaugurated by technology people in the U.S. Department of Education, asked interested educators to discuss five questions:

1. What professional development do teachers need in order to use technology in ways that help students learn?
2. How can technology itself be used to help teachers learn?
3. Are there any schools or communities that are currently using technology effectively for professional development?

4. What can be done to strengthen those efforts? What can be done to encourage more efforts?
5. What should be the role of the federal government in promoting the use of technology for the professional development of teachers?

Are these the *right* questions? **Yes**, some of them are, especially those that target the teacher as a key player in the process. Decisions can be made from the "top" but unless the classroom teacher is convinced that change is important and has the knowledge and skills to make it happen, innovations will languish even as equipment gathers dust.

Are these the *right* questions? **No**, because they do not go far enough and deep enough. If we could only ask questions about where students are in the learning curve; if only we could ask questions about what it is that we want learners to accomplish in a given period of time; and if only we could explore the methods that engage learners ("turn them on") and help them to become responsible for their own learning then we would find the ways in which technology as our tool and ally could be appropriately used to accomplish our educational mission.

We are too eager for instant results in this age of fast foods, drive-in windows and FAX communication. Immediate feedback, instant gratification and confirmation without delay are the order of the day. North America is one part of the world where technology has contibuted to the solution of many problems, e.g. the nature of our galaxy, the causes for diseases; and universal telecommunications. It is natural, therefore, that we should turn to technology to answer the questions and solve the problems of teaching and learning in schools. But the setting, the expectations, the human interactions that make up this milieu are not always susceptible to technological solutions and certainly not to some solutions that must be implemented over time. We have been brought up on the myth that almost any problem can be solved with a technological solution. In Education, this assumption is dangerous and in terms of technology, it can be disasterous.

Using Technology Effectively

One of the U.S. Department of Education questions seems especially worth exploring: "Are there any schools...that are currently using technology effectively...?" Yes there are. Where are they? (I expect you can name a few in your area or state.) Our ERIC Clearinghouse at Syracuse University has just published a comprehensive report of the Peakview Elementary School District in Colorado that incorporates some of the most sensible and appropriate applications of technology I have come across. Let me briefly describe some of the activities going on in that school district.

Peakview is a new school that is implementing many organizational changes and teaching strategies advocated by the school restructuring movement. Among the strategies is the placement of more than 80 networked computers in classrooms. A study of the Peakview program discovered that technology had a positive effect on student learning and attitudes. Teachers are using technology to adapt to student needs and interests and to increase the amount and quality of cooperative learning activities. Students use the technology extensively for research and writing and for learning support. Technology has changed the way teachers work professionally resulting in a net increase in hours and greater productivitly, effectiveness and satisfaction.

Many factors contributed to the success of Peakview's use of technology:

* **Computers are abundantly available in the classroom.** Each classroom has at least 4 computers and adjoining classrooms share their computers.

* **Shared commitment and vision of school reform with technology is an essential component.** An environment was cultivated over time that encouraged mutual support and sharing of resources.

* **A supportive district and principal.** The principal and staff worked with the district administration to develop a set of innovative values; the principal learned to use computers along with the teaching staff.

* **A strong computer coordinator.** One full-time teacher assigned to provide

leadership and support was critical to the success of the program.

* **Early and thorough teacher training.** Before the school opened, teachers received training and instructional software to be used in classes. Continuing in-service education is available.

* **Taking computers home.** After training in the school, teachers were given a computer to take home for 6 weeks. They became comfortable with the computers and many received help from their children.

* **User-friendly systems.** Easy-to-use hardware and quality software contributed to successful implementation. (Wilson, Teslow, Cyr and Hamilton, 1995).

It is obvious from this case study that planning over time and active participation help to facilitate the implementation.

Planning

We can develop guidelines for the use of technology in schools based on the successful experience of schools like Peakview (and others) who seem to have put it all together in appropriate and creative ways.

I would like to start with the **conditions** that seem to facilitate the implementation of educational technology based on my research in this area (Ely, 1990). In schools where technology has been successfully implemented, there appear to be certain conditions that are consistent from one location to another. They are:

1. **Dissatisfaction with the status quo.** Teachers, administrators, parents, school boards and community believe that there are aspects of schooling that could be improved. They are not pleased with the current outcomes and want a change for the better. Dissatisfaction is turned into a call for action.
2. **Knowledge and skills.** To fully and appropriately implement the use of any type of hardware and software, the individual must feel confident in its operation and sense its relevance for tasks that they perform. The Peakview teachers had a long period of initial training and continuing assistance.
3. **Resources.** Hardware and software are the obvious resources but other types of resources, such as those provided in a library media center and additional optional

software help the teacher to feel that there is support.

4. **Rewards and incentives.** There are different types of rewards for different people. Some perceive in-service training and hardware/software to be rewards. If they are trained on "paid" time, this is another reward. The ability to take a computer home for a period of time serves as another incentive. Recognition by the principal at an open meeting; a report in the local paper; and a feeling of collegiality among peers often serve as rewards.

5. **Commitment.** The Peakview community--particularly the teachers and the administration--articulated a vision for the school , and they made a commitment to implement that vision. The belief that we can do it and we will do it is a driving force that is necessary not only to begin but to sustain an innovative effort in a school.

6. **Leadership.** Leadership occurs at many levels. In Education, it sometimes comes from the Federal and State governments; closer to home it is the district superintendent and board and even closer, in the local school building it is the principal and key staff members. When it comes to technology in the schools, the existence of a "hands-on" person, such as the Computer Coordinator at Peakview, makes all the difference between active and thorough implementation and casual, luke-warm use.

7. **Time.** In almost every study about the diffusion, adoption and implementation of technology in education, the time factor is rated as the most important condition leading to successful use. It takes time to plan, time to learn, time to integrate technology into the on-going curriculum and time to evaluate the outcomes. Time must be given during the school year for such activities; paid time during Summers is sometimes necessary. To ask teachers to spend their own time from midnight to 2:00am and weekends in order to implement new technology is an unreasonable demand.

8. **Participation.** When people have the opportunity to participate in the process of planning and designing new ways to accomplish innovative movements, they will

become "stakeholders" in the outcome. When individuals "buy-in" to technology applications, for example, they possess "ownership" of the idea along with those who introduced it. When people play a part in determining their own destiny, they will usually become advocates and facilitators in making an innovation work. Peakview obviously involved all individuals and groups who had a vested interest in the outcome of the project and they were exceptionally successful.

At the heart of the change process is the belief that we can no longer teach all the knowledge that individual students will need in the future. Since we cannot expect students to learn all the answers, we must help them to learn how to raise the right questions and then help then to learn where to go to get the information and how to find it and apply it. This is a big order BUT in an era when the amount of information available exceeds that which was available at any time in history, we have to reconceptualize our schools and make a qualitative change in the nature of learning itself. This is the challenge to Education today. If *Technology is the Answer!* the questions are:

How can we create the conditions for learners to become increasingly responsible for their own learning?

How can we help learners to use the tools that are required for survival in a technological society?

How can we "humanize" technology in the service of all people?

How can we help learners to raise the "right" questions?

The *answers* are not in the technology itself but in the people who decide about the purpose of its use, the way in which it is used and the manner in which we evalute the consequences of our decisions.

Beyond these specifics are the questions about creating a vision; about energizing a school and community to explore new (ans sometimes risky) ideas; about moving toward that vision together. One of the best expressions of the attitude I am trying to describe was written at the close of John Steinbeck's short novel, *The Red Pony*. The grandfather is recalling his trek to the West when he was

young:

> "It wasn't the Indians that were important, nor adventures, nor even getting out here. It was a whole bunch of people made into one big crawling beast. And I was the head. It was westering and westering. Every man wanted something for himself, but the big beast that was all of them wanted only westering. I was the leader, but if I hadn't been there, someone else would have been the head.
>
> "Under the little bushes the shadows were black at white noonday. When we saw the mountains at last, we cried--all of us. But it wasn't getting here that mattered, it was movement and westering.
>
> "We carried life out here and set it down the way those ants carry eggs. And I was the leader. The westering was as big as God, and the slow steps that made the movement piled up and piled up until the continent was crossed.
>
> "Then we came down to the sea, and it was done." He stopped and wiped his eyes until the rims were red....The old man smiled.
>
> "There's no place to go. There's the ocean to stop you. There's a line of old men along the shore hating the ocean because it stopped them....No place to go....Every place is taken. But that's not the worst--no, not the worst. Westering has died out of the people. Westering isn't a hunger any more. It all done....It is finished." (p. 213)

Westering today is the exploration of the many applications of computer and multimedia technology. In school and university settings educators are discovering rich and bountiful resources as never before. At times it appears to be an embarassment of riches. Where will this westering end? At the mountains? At the ocean? Westering by itself drives people to explore previously unknown territory and I would not want to discourage such adventures. They often yield riches beyond imagination. Sometimes they lead to the sea and "There's the ocean to stop you." Unless our westering has vision, direction and humane goals, the process

itself is an end-- an end without reward. Technology can be a siren call luring the unsuspecting educator into the cave that becomes a deep, dark hole; but it can also be the vehicle that lifts us from the ordinary and mundane and helps us to achieve what I believe is the most important goal in education: to help each learner become responsible for his or her own learning. Call it westering...call it the "right" question...call it humane technology; whatever its name, it is education for the 21st Century.

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